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AN EVALUATION OF THE PINE BUTTERFLY[1] POPULATIONS ON THE BOISE, PAYETTE, AND SALMON NATIONAL FORESTS, 1982

by
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ABSTRACT

The pine butterfly caused visible defoliation over approximately 5,800 acres of ponderosa pine in and around the Boise and Payette National Forests in 1982. Populations were evaluated, and 1983 defoliation predictions have been generated. Many areas harbor increasing populations, but 1983 defoliation will continue to be localized. Defoliation intensity will range from negligible to heavy.

INTRODUCTION

Beginning in 1979, flights of pine butterflies, Neophasia menapia (Felder and Felder), have become increasingly conspicuous throughout much of the ponderosa pine type on the Boise National Forest and surrounding State and private lands. Defoliation was first noticed near Dry Buck Summit northwest of Banks, Idaho, in 1981 where over 500 to 600 acres of ponderosa pine were affected.

In 1982, defoliation intensified around Dry Buck Summit, and a second area of defoliation was identified north of Cascade, Idaho. Butterfly flights also became more widespread and were reported on the Boise, Payette, and Salmon National Forests. From August through October 1982, I evaluated the butterfly populations and existing defoliation in an effort to (1) predict 1983 defoliation potential and (2) assess the influence of predators and parasites.

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METHODS

Population Assessment

To predict 1983 defoliation I employed egg sampling techniques and procedures outlined by Bousfield and Dewey (1972). Six 5-inch apical twigs were collected at midcrown from each of 10 trees at each evaluation site and taken to the laboratory for examination. Additionally, 20 trees at each evaluation site were subjectively assessed for current defoliation and the percent of trees with defoliation computed.

Selection of evaluation sites was based on previous assessments (Thier 1982, Valcarce 1972, 1973) and knowledge of existing butterfly activity. Twenty sites on and around the Boise, Payette, and Salmon National Forests were sampled. Figure 1 shows the location of the sites on and around the Boise and Payette National Forests.

In the laboratory apical twigs were examined for egg deposition. Eggs were counted and categorized as viable or nonviable. Data were then used in the following equation to develop prediction indices for 1983 defoliation (Bousfield and Dewey 1972):

$$Y = -0.0659 + 0.0141\ (X_1) + 0.02\ (X_2), \text{ where}$$

Y = predicted defoliation index
X_1 = mean number of viable eggs/5-inch branch
X_2 = percentage of trees with current defoliation

So that indices (Y) are useful in quantifying predicted defoliation, they were converted to predicted percent defoliation and then for ease of discussion to defoliation category by interpolation in the following table.

Defoliation Index	Predicted Defoliation (%)	Predicted Defoliation Category
0	0	Negligible
1	25	Light
2	50	Moderate
3	75	Heavy
4	100	Severe

Parasite Evaluation

In early August 1982, I collected over 200 pine butterfly pupae from the Dry Buck Summit area. In the laboratory, 120 pupae were randomly selected and 20 were placed in each of six screened rearing jars. I examined the pupae daily to count and remove emerging butterflies and parasites. Parasites were sent to specialists for identification. Pupae, from which neither a parasite nor butterfly emerged, were dissected to ascertain cause of death.

Defoliation Survey

As part of the annual FPM insect surveillance program, aerial surveys were conducted in August 1982 to detect and delineate pine butterfly defoliation.

RESULTS AND DISCUSSION

Pine butterfly eggs were found on foliage from 17 of the 20 evaluation sites (table 1) located on all three National Forests. Large numbers of eggs were found at Arling Hot Spring No. 2 and No. 1, Pearsol Creek, and Dry Buck Nos. 1 and 2. No eggs were found at the Cow Creek, Scriver Creek, and Henry's Creek sites on the Boise National Forest. The rest of the areas had low numbers of eggs.

Where evaluation sites were sampled both in 1981 and 1982, the relative change in the size of the resident butterfly population was determined by comparing the mean number of viable butterfly eggs in 1981 and 1982 (table 2). While populations increased significantly at Pearsol Creek, and slightly at nine evaluation sites, they declined slightly at three sites and significantly at the Dry Buck Summit No. 1 evaluation site.

As indicated in the "Methods" section of this paper, predicted defoliation indices are based on both viable egg counts and an assessment of defoliation present. These indices are, in turn, used to determine predicted percent defoliation and predicted defoliation categories. Predicted 1983 values range from negligible, at the majority of the sites, to heavy at Arling Hot Spring No. 2 (table 3). Moderate defoliation is predicted at Arling Hot Spring No. 1 and at both Dry Buck Summit sites. All these sites are on or adjacent to the Boise National Forest.

Predictive information presented above addresses only defoliation expected in 1983. It does not indicate infestation trend for specific areas. To determine infestation trends for evaluation areas 1982 and 1983 defoliation indices were compared (table 3) where data were available. An upward trend of defoliation was established for six areas (table 3): Bear Run, Lick Creek, Little Pearsol Creek, Pearsol Creek, and Scriver Creek on the Boise National Forest and Boulder Creek on the Payette National Forest. A downward trend was noted at Cow Creek, Dry Buck No. 1, Harris Creek Summit, and the North Fork of Rabbit Creek on the Boise National Forest. Those units with positive defoliation trends may sustain increased defoliation within the next 2 to 3 years if natural controls discussed below do not become limiting. Trends could not be established for areas not sampled previously.

Egg predation was evident at 10 evaluation sites (table 1), ranging from slightly over 24 percent at Lick Creek and Arling Hot Spring No. 2 to slightly over 1 percent at Arling Hot Spring No. 1. Lick Creek, Arling Hot Spring No. 2, Dry Buck Summit No. 1, Station Creek, Anderson Creek, and

Table 1.--Pine butterfly egg predation on the Boise, Payette, and Salmon National Forests in 1982

Area	Mean Number of Eggs/5-Inch Twig		Percent Egg Predation
	Total Eggs	Destroyed by Predation	
Boise NF			
Lick Creek	3.05	0.75	24.59
Arling Hot Spring #2	63.72	15.47	24.27
Dry Buck Summit #1	11.78	1.27	10.75
Station Creek	0.17	0.02	9.8
Pearsol Creek	21.37	1.63	7.64
Dry Buck Summit #2	14.00	0.60	4.29
Little Pearsol Creek	4.43	0.07	1.50
Arling Hot Spring #1	40.0	0.55	1.37
N. Fk. Rabbit Creek	0.72	0	0
Harris Creek Summit	0.65	0	0
W. Fk. Sixmile Creek	0.47	0	0
Bear Run	0.17	0	0
Cow Creek	0	0	0
Scriver Creek	0	0	0
Henry's Creek	0	0	0
Payette NF			
Anderson Creek	8.58	1.75	20.4
Brown's Pond	0.20	0	0
Railroad Saddle	0.20	0	0
Boulder Creek	0.02	0	0
Salmon NF			
Colson Creek	3.37	0.60	17.8

Table 2.--Mean number of viable pine butterfly eggs per 5-inch twig - 1981, 1982.

Area	Mean No. Viable Eggs/5-Inch Twig 1981 [1]	1982
Boise NF		
Arling Hot Spring #2	NS [2]	48.25
Arling Hot Spring #1	NS	39.47
Pearsol Creek	2.35	19.73
Dry Buck Summit #2	NS	13.4
Dry Buck Summit #1	33.67	10.52
Little Pearsol Creek	0.40	4.37
Lick Creek	0.10	2.3
North Fork Rabbit Creek	0.13	0.72
Harris Creek Summit	0.27	0.65
West Fork Sixmile Creek	0	0.47
Bear Run	0	0.17
Station Creek	0.20	0.15
Cow Creek	0.37	0
Scriver Creek	0.28	0
Henry's Creek	0	0
Payette NF		
Anderson Creek	NS	6.83
Boulder Creek	0	0.20
Brown's Pond	0	0.20
Railroad Saddle	0	0.20
Salmon NF		
Colson Creek	NS	2.77

1/ Data from Thier 1982
2/ NS - Not sampled

Table 3.--Potential defoliation by the pine butterfly on the Boise [1], Payette, and Salmon National Forests in 1983

Area	1982 [2] Defoliation Index	1983 Predicted Defoliation Index	1983 Predicted Percent Defoliation	1983 Defoliation Category	Trend [3]
Boise NF					
Arling Hot Spring #1	NS [4]	2.1	53	Moderate	--
Arling Hot Spring #2	NS	2.6	65	Heavy	--
Bear Run	0	0.9	5	Negligible	↑
Cow Creek	1.9	0	0	Negligible	↓
Dry Buck Summit #1	2.4	2.1	53	Moderate	↓
Dry Buck Summit #2	NS	2.1	53	Moderate	--
Harris Creek Summit	0.3	0.1	1	Negligible	↓
Henry's Creek	0	0.1	1	Negligible	→
Lick Creek	0	0.2	1	Negligible	↑
Little Pearsol Creek	0	1.4	34	Light	↑
N. Fk. Rabbit Creek	1.6	1.2	29	Light	↓
Pearsol Creek	0.4	0.8	4	Negligible	↑
Scriver Creek	0.1	0.7	4	Negligible	↑
Station Creek	0	0	0	Negligible	→
W. Fk. Sixmile Creek	0	0.1	1	Negligible	→
Payette NF					
Anderson Creek	NS	0	0	Negligible	--
Boulder Creek	0	0.4	2	Negligible	↑
Brown's Pond	0.1	0	0	Negligible	→
Railroad Saddle	0	0	0	Negligible	→
Salmon NF					
Colson Creek	NS	0	0	Negligible	--

1/ Includes adjacent private lands
2/ Data from Thier 1982
3/ Trend: -- unable to establish due to missing data, → static, ↑ increasing, ↓ decreasing. Established from comparison of 1982, 1983 defoliation indices.
4/ NS - not sampled

Colson Creek all sustained a significantly higher than average level of predation. The importance of egg predation in controlling the pine butterfly population is unknown (Cole 1956).

Sixty-five percent of the pine butterfly pupae held for rearing were killed by parasites (fig. 2). Theronia atalantae fulvescens (Cresson), an ichneumonid wasp, was the major parasite; and a single specimen of Ceromasia auricaudata Tns., a parasitic tachinid fly, was also reared (fig. 2, table 4). An additional 25 percent of pupae collected died with no sign of parasitism; only 10 percent of the pupae emerged as adults (fig. 2). The wasp has been credited with eventual control of pine butterfly epidemics (Cole 1956). Since both parasites are established at Dry Buck Summit, I suspect they may be responsible for the downward trend and will soon cause the infestation in the area to collapse.

In 1982, aerial surveys revealed that about 5,800 acres of ponderosa pine were moderately to severely defoliated at two separate areas on and around the Boise National Forest (fig. 1). Defoliation became more extensive around Dry Buck Summit, and a second defoliated area was noted around Arling Hot Spring. Aerial surveys will probably detect further butterfly-caused defoliation in the next few years since other more intensive surveys, such as egg sampling, have a limited scope.

MANAGEMENT ALTERNATIVES

Maintain Present Management

Under this alternative, infestations will be allowed to continue unabated. Outbreaks usually last 2 to 5 years before they are controlled by predators and parasites which are increasing in several areas sampled. Both tree mortality and reduced growth may occur. In the 1920's, defoliation alone resulted in 12-percent mortality; however, in the 1950's, no mortality attributed solely to defoliation occurred (Cole 1966). Trees weakened by pine butterfly defoliation may also be predisposed to attack by bark beetles. Previous studies have shown that losses to bark beetles range from 1.3 to 14.0 percent (Evenden 1940, Cole 1966). In both of these outbreaks, a 39-percent reduction in normal growth increment was measured (Evenden 1940, Cole 1966).

Silvicultural Management

Evenden (1940) found that tree vigor, before defoliation, was important in a tree's ability to recover from defoliation. Silvicultural management minimizes insect and disease impacts by maximizing tree vigor. I speculate that prescriptions which favor stand species diversity and maintain vigorous stand growth will minimize defoliation impacts. Since silvicultural management is a long-term action, little could be done to suppress the current infestation.

Figure 2. PUPAL PARASITISM AND ADULT EMERGENCE FROM PINE BUTTERFLY PUPAE COLLECTED AT DRY BUCK SUMMIT, BOISE N.F. 1982

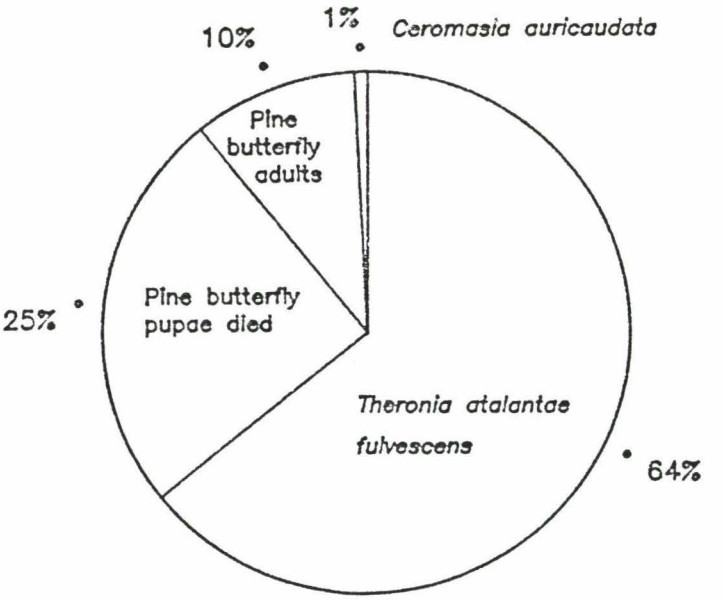

Table 4. SUMMARY OF PUPAL PARASITISM AND ADULT EMERGENCE FROM PINE BUTTERFLY PUPAE COLLECTED AT DRY BUCK SUMMIT

	No. pine butterfly pupae	No. parasites *Theronia atalantae*	No. parasites *Ceromasia auricaudata*	No. pupae died	No. adult butterfly
	20	17	0	2	1
	20	13	0	5	2
	20	9	0	11	0
	20	13	0	4	3
	20	13	0	5	2
	20	12	1	3	4
Ave.	20	12.8	0.2	5.0	2.0

Direct Suppression

The Environmental Protection Agency registers only one insecticide for pine buttefly suppression--the microbial insecticide, Bacillus thuringiensis Berliner. This insecticide kills lepidopterous insects without adversely affecting other plant, animal, or insect species; but its effectiveness has been inconsistent.

RECOMMENDATION

The "maintain present management" alternative is recommended for the current outbreak. Based on the population trends and predator-parasite complex at Dry Buck Summit, the outbreak populations at Dry Buck Summit and Arling Hot Spring should soon collapse. However, if significant numbers of trees are killed by defoliation or bark beetles, then a sanitation-salvage operation may be considered if economically and environmentally feasible.

I recommend the silvicultural management alternative be considered as a long-term means to minimize the impacts of future pine butterfly outbreaks if this alternative is economically and environmentally feasible.

ACKNOWLEDGMENTS

Dr. V. K. Gupta, Center for Parasitic Hymenoptera, Gainesville, Florida, verified my identification of Theronia atalantae fulvescens (Cresson), and C. W. Sabrosky of the USDA Systematic Entomology Laboratory determined Ceromasia auricaudata Tns. C. Weiland helped edit the manuscript.

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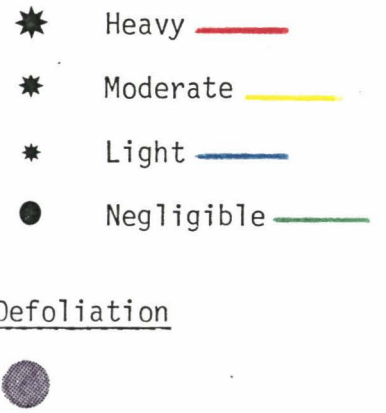
Figure 1.--Boise and Payette National Forests' 1982 pine butterfly evaluation sites and predicted 1983 defoliation.

Site Name	Map Number
Bear Run	1
Cow Cr.	2
Dry Buck Summit #1	3
Harris Cr. Summit	4
Henry's Cr.	5
Lick Cr.	6
Little Pearsol Cr.	7
North Fork Rabbit Cr.	8
Pearsol Cr.	9
Scriver Cr.	10
Station Cr.	11
West Fork Sixmile Cr.	12
Boulder Cr.	13
Brown's Pond	14
Railroad Saddle	15
Arling Hot Spring #1	16
Arling Hot Spring #2	17
Dry Buck Summit #2	18
Anderson Cr.	19



LEGEND